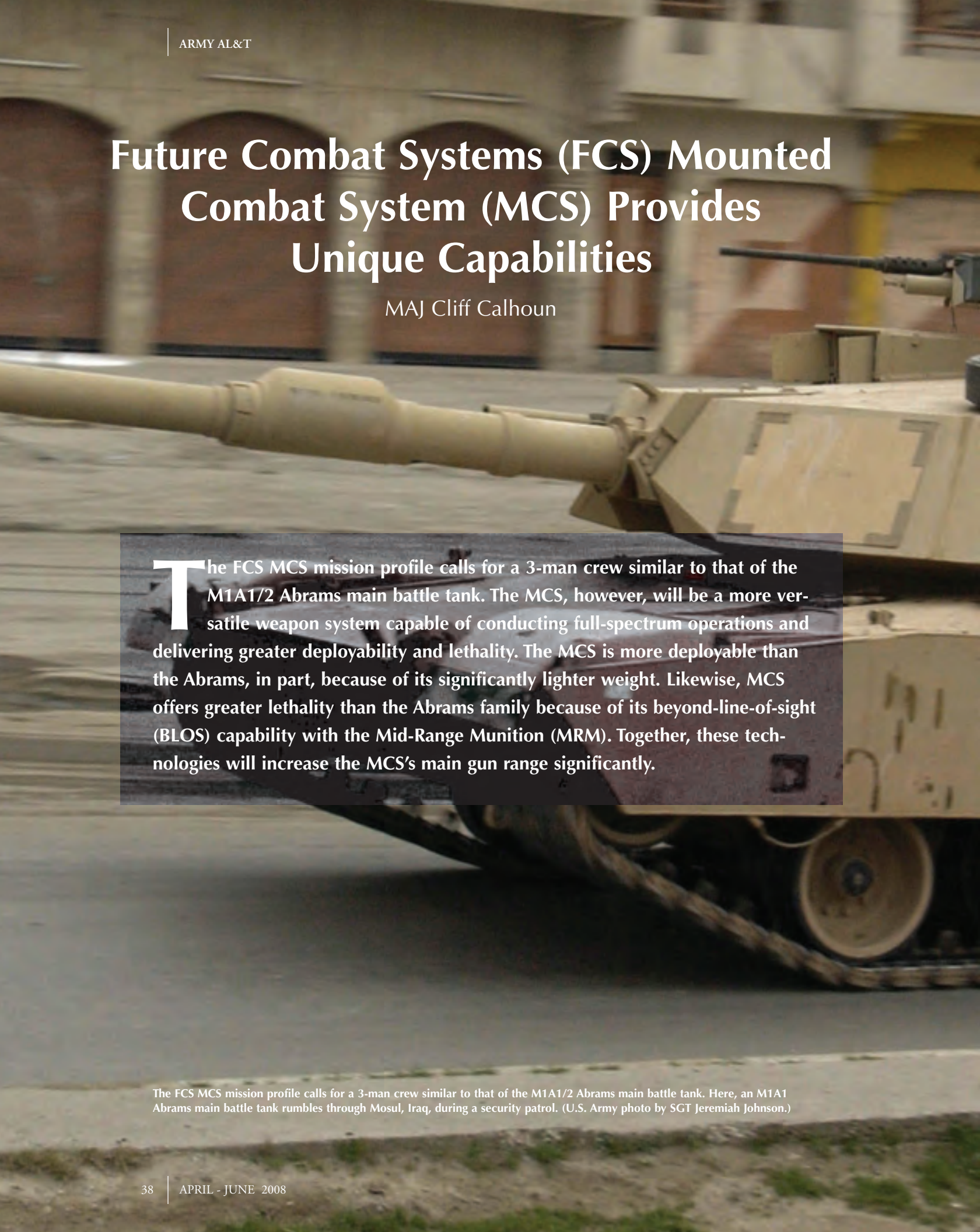
Future Combat Systems (FCS) Mounted Combat System (MCS) Provides Unique Capabilities

MAJ Cliff Calhoun



The FCS MCS mission profile calls for a 3-man crew similar to that of the M1A1/2 Abrams main battle tank. The MCS, however, will be a more versatile weapon system capable of conducting full-spectrum operations and delivering greater deployability and lethality. The MCS is more deployable than the Abrams, in part, because of its significantly lighter weight. Likewise, MCS offers greater lethality than the Abrams family because of its beyond-line-of-sight (BLOS) capability with the Mid-Range Munition (MRM). Together, these technologies will increase the MCS's main gun range significantly.

The FCS MCS mission profile calls for a 3-man crew similar to that of the M1A1/2 Abrams main battle tank. Here, an M1A1 Abrams main battle tank rumbles through Mosul, Iraq, during a security patrol. (U.S. Army photo by SGT Jeremiah Johnson.)

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The FCS MCS will provide unique capabilities to the FCS Brigade Combat Team (BCT) through several new technologies and advanced manufacturing processes. As compared to the Current Force, the MCS offers greater lethality at a lighter weight. For the MCS to fulfill its mission, a tailored mission module is essential for the system to meet transportability requirements, and new ammunition is required to enable BLOS engagements.

MRM

To maintain survivability while being capable of defeating enemy main battle tanks, the MCS will stretch the battlefield with the situational awareness gained through the system-of-systems network and high density of sensors. With the 120mm XM360 gun and the BLOS-capable MRM, the BCT commander will be able to maneuver "out of contact" to positions of advantage, helping provide standoff from the enemy's lethality envelope. Through the integrated sensor network, the MCS will be able to process information about targets throughout the FCS(BCT) operational environment and destroy targets with its main gun and MRM through both LOS and BLOS engagements. BLOS engagements are not a different way to do indirect fire, but an extension of close combat direct fire. BLOS employs direct fire targeting because the gunner pulling the trigger sees the target directly through a sensor system. This will enable future gunners to kill targets at significantly greater ranges than their Abrams gunner predecessors.

The MCS offers greater lethality than the Abrams family because of its BLOS capability with the MRM. (U.S. Army photo.)

The MRM cartridge is a "fire-and-forget" gun-launched munition that will provide the MCS with BLOS lethality, and the MCS will be able to fully employ the MRM at its greatest range. MRM operates in three modes:

- In *autonomous* mode, the fired round searches for and engages a target.
- In *designate* mode, the MRM searches for a laser spot and engages. If the spot is lost or not found, it reverts to autonomous mode.
- In *designate only* mode, the MRM will designate but not revert to autonomous mode.

Prior to firing, battlefield command and control information from the network is transmitted through an Ammunition Data Link (ADL) that allows

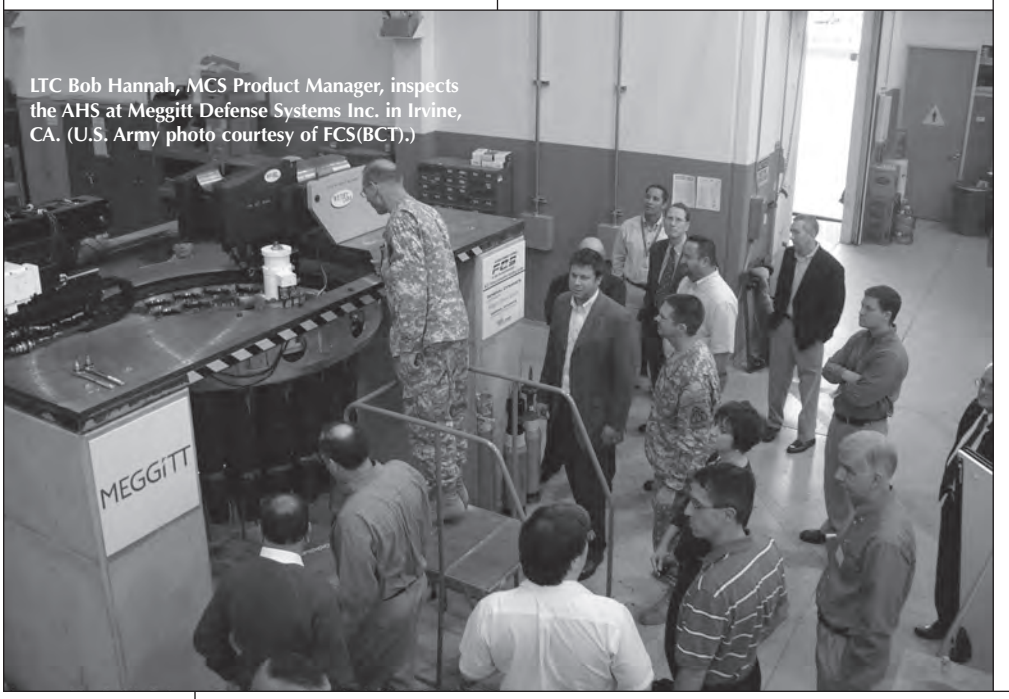
the MRM to communicate with the MCS fire control system. In other words, the network signals the MCS and the ADL provides target information to the MRM. The ADL then transmits the firing solution information that the MRM needs to guide itself to the target. Once fired, no further command from the MCS is required. The MRM and ADL capabilities are key to the FCS(BCT), but must be delivered in a lighter weight gun than is currently available.

Lethality at a Lighter Weight

Since the MCS is a much lighter platform than the M1 Abrams family, it requires a lighter gun than the Abrams M256. This lighter gun must provide lower recoil while offering the Abrams the ability to fire 120mm ammunition. To meet this challenge, the lightweight 120mm gun is being produced at Watervliet Arsenal, NY, and designed by Benet Laboratories under a Cooperative Research and Development Agreement (CRADA) between the U.S. Army Armament Research, Development and Engineering Center and General Dynamics Land Systems. One requirement dictated under the CRADA is that the primary weapon assembly (PWA) must be capable of firing all 120mm ammunition currently in the Army's inventory as well as planned developmental ammunition. The gun was developed to replicate the current 120mm M256 cannon's performance on the M1A2 in a lightweight, compact design. The mission configuration for XM360 is 2,100 pounds lighter than the M256, and this lighter weight requirement drives several gun characteristics.

The PWA uses a high-efficiency muzzle brake to reduce firing shock to the vehicle and crew and to provide reduced impulse for the MCS's lighter weight. Through a series of holes at the end of the barrel (pepperpot), the muzzle brake redirects some of the escaping propellant gasses. This redirection reduces firing impulse and manages the blast field to dampen recoil force. This system helps the MCS to fire 120mm main gun ammunition from a vehicle weighing roughly half the Abrams weight.

To achieve this reduced weight, the gun features a lightweight mount, compact cradle design, titanium recoil rails, modular recuperators and recoil brakes. The greatest potential for weight reduction in a large caliber weapon is in the barrel. In the PWA, ultra-high-strength materials are used to reduce the wall thicknesses when compared to the M256. The tube itself is made from ultra-high-strength gun steel with a composite wrap using the filament wound process. To compensate for muzzle movement from the lighter barrel, the FCS program is developing two new technologies to be used with the PWA: the Dynamic Muzzle Reference Sensor (DMRS) and the Advanced Fire Inhibit System (AFIS). DMRS and AFIS are both expected to have prototypes demonstrated in relevant environment by the MCS Critical Design Review.



LTC Bob Hannah, MCS Product Manager, inspects the AHS at Meggitt Defense Systems Inc. in Irvine, CA. (U.S. Army photo courtesy of FCS(BCT).)

DMRS and AFIS

A consequence of reduced weight is increased gun tube flexure. This movement is amplified when the vehicle is moving. The AFIS is being integrated to compensate for this movement and improve MCS accuracy, especially during on-the-move engagements. The AFIS provides an accuracy-enhancing, muzzle position prediction algorithm. The DMFS will measure the bend angle of the gun muzzle with respect to the gun mount and provide the AFIS with the data necessary to compensate for the muzzle movement. This measurement enables the AFIS to use its algorithms to inhibit the trigger-pull initiated firing pulse until the optimal moment. The DMFS/AFIS enhanced fire control is expected to reduce MCS impact dispersion by nearly one-third. This will significantly increase hit probability at extended range, increasing system lethality. This lethality is also enhanced by the MCS's ability to deliver a high sustained rate of fire through its Ammunition Handling System (AHS).

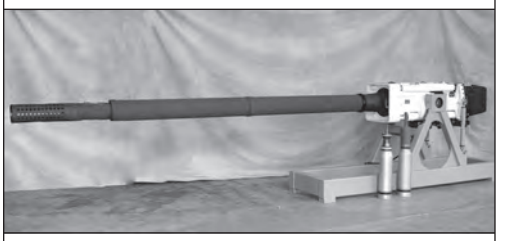
The 120mm XM360 gun shown here undergoing testing will enable the FCS(BCT) commander to better maneuver to positions of advantage to avoid enemy direct fire. (U.S. Army photo courtesy of FCS(BCT).)

AHS

The roles on the MCS 3-man crew go to the vehicle crewman (whose duties most closely resemble that of the Abrams driver), the mission specialist (gunner) and the crew chief (tank commander). The main gun is not loaded by a crew member, but instead through the fully automated AHS whose Turret Transfer Unit (TTU) interfaces with the Turret Basket Magazine (TBM) to load the XM360. By automating the loading function, the AHS removes that burden from the crew. With a 3-man instead of a 4-man crew, the FCS(BCT) will realize significant military personnel savings for Future Forces.

Unlike a crew member, the autoloader will not physically tire, so the AHS-equipped MCS will be able to provide the rate of fire required to destroy targets throughout a wide sector. To meet the MCS's stretched battlefield demands, the AHS features a ready-round TBM that is compatible with both current and developmental 120mm ammunition (9 more ready rounds than the M1A2). Careful handling is a concern with the Army's caseless ammunition, so the TBM canisters support the ammunition by both the case base and the warhead to help prevent ammunition damage.

An XM360 test firing at Aberdeen Proving Ground, MD. (U.S. Army photo courtesy of FCS(BCT).)



Lethality is enhanced by the MCS's ability to deliver a high sustained rate of fire through its AHS (shown here). (U.S. Army photo courtesy of FCS(BCT).)

The interface between the TBM and the gun that is incorporated to upload, download, load, unload, stubcase eject and misfire eject is the TTU. Through testing, the TTU proves to provide positive control to accurately place ammunition in the PWA and prevent damage to the round. The system incorporates the Round Identification Camera Unit to identify the type of ammunition being loaded. The camera reads the standard marking on the main gun ammunition's case base using optical character recognition. By identifying each round as it is loaded, the system will place ammunition in the TBM so that it remains balanced. One final safety measure is an ultrasonic sensor in the TTU that will diagnose the separation of a round during operation, should that occur.

Path Ahead

To reduce risk and improve system readiness, the MCS team is integrating the PWA and related technologies in a firing fixture, which is essentially a turret on a test stand that will provide valuable data to alleviate production risks and provide new capabilities to Soldiers. Testing plans include development and safety testing of the guns from 2007 to 2009, and integration of the guns into MCS preproduction vehicles in 2009-2010. Successful testing and integration are the key factors that will enable the MCS to conduct full-spectrum operations and to "deliver precision fires at a rapid rate to destroy multiple targets at standoff ranges."

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